11-17-05 "Chpt 5 Test Starts Here"

The Periodic Table

- Dimitri Mendeleev → (1869) - published his 1st table. → elements were arranged by increasing mass & were grouped together by chemical & physical properties.
  - reversed from today's → periods vs families
  - "?"s / - gaps in table → predict elements would be discovered → found some elements later
- 2 problems w/ table
  1) how come certain elements (ex Te, I) can not be grouped by increasing mass?
  2) why periodicity (elements w/ similar properties would recur at reg. intervals)
     ↳ keeps cycling. [idea of pendulum]
- 1908 → discovery of nucleus → crossing for new table → elements - diff. nuclear charges
- 1911 → Mosely → rearranges elements by order of increasing nuclear charge.
  → answers Q #1. → Te → #52 ; 128 → just had more neutrons. ; has a lower nuclear charge so it SHOULD come 1st!
  → I → #53 ; 127.
- can't explain periodicity
  → just states → Periodic Law → phys. & chem. prop.s of elements are periodic functions of their atomic #
  ⇒ [as elements are arranged by increasing atomic #, elements w/ similar properties recur at reg. intervals]

11/18 Periodic Table

Group 1 → 1 valence e⁻
Group 2 → 2 valence e⁻ Columns

d Block → 2 val e⁻ (except Mo, Cr, Ag, Au, Cu)
p Block → Group # - 10 valence e⁻

Group 1 - alkalimetals (ns¹)
soft, silvery, highly reactive metals
do not exist freely in nature
react readily with water
$2Na + 2H_2O \rightarrow 2NaOH + H_2$
reactivity increases down the group
(all have ion w/+ charge)
Melting Tep Decreases down the group
(all melt below 100°C)

protons

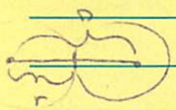
11-22-05

- Gr 1 → general e^- config of ns^1
- Gr 2 → general e^- config of ns^2
  - ↳ not as reactive as Gr 1 elements but they still aren't found freely in nature.
    - b/c s-orbital are full ⟹ semi-stable [more so compared to Gr 1]
  - ↳ harder, denser, have higher melting temp. than Gr 1
    - (harder) more nucleus; (higher melting temp.) b/c are more stable.
  - ↳ have 2+ charges.
  - Ca → makes part of earth crust.
  - Mg → sea water
- Gr 2 → called the alkaline earth metals
- D-Block → e^- config. : $(n-1)d^* ns^2$
  - ↑ E-level / period #
  - * → varies to where one is in the group. / relates to position in group. [period]
  - → called the transition metals
    - all have props. of metals — transition to metallic to nonmetallic.
    - → luster
    - → ductile
    - → maleable
    - → conduct heat & electricity
    - → high tensile strength
    - they are much more stable than s-block
    - some are found freely in nature
    - much higher melting temps. (ex W) [MT]
    - most are solids at room temp. (besides Hg)
  - • val e^-s → mostly have $2e^-$s.
  - behaves to a degree of a Noble Gas.
- P-Block → e^- config. : $ns^2 np^*$
  - • val e^- → Gr # - 10 = # of val. e^-s.
  - ↳ composed of metals, nonmetals & metalloids.
    - nonmetals: - brittle; - insulators; - dull; → could be gas, liquid or solid at room temp.
    - metalloids: characteristics of both metals & nonmetals. [seen w/ zigzag line] → mostly solid at room temp.
    - above line → nonmetals.
- Gr. 17 (the Halogens) → highly reactive nonmetals. [one e^- away from having a full octect]
  - ex :Cl: + e^- → :Cl: [w/ 1 e^- → get noble gas configuration]
  - → some gases, others liquids, others solid at room temp.
  - → exist diatomically (found in nature in 2) → ex. Cl_2, F_2, I_2, Br_2
    - ex. w/ Cl → :Cl: Cl:
  - • all have 1(-) charge.
- Gr 18 (Noble Gases) → highly unreactive, AKA inert gases. → b/c they have a full octect. [outer shell] ⟹ stable config.
  - on mendaleevs table → wasn't there b/c couldn't discover them b/c they're so inert.
- F-Block → 2 rows → lanthanides; → actinides
  - lanthanides - highly reactive, shiny metals, unstable → used in color TV's
  - actinides - radioactive, manmade elements.

11-22-05

Trends

- Atomic Radius (AR) → the radius of an atom...
  - problem → no definitive boundary where the atom is. (since e^- clouds are probability)
  - solution → 1/2 distance of nuclei of adjacent atoms.



"Anderson model": $\frac{D}{2}$ = AR.

- Across the period (L → R) → AR ↓ b/c nuclear charge increases across the period pulling e^-s in closer.
  - nuclear charge ↑ [more protons] => atomic radius ↓

- Down a group → AR ↓ b/c there's more E-levels added farther away from the nucleus making the atom larger.
  - exceptions → w/ orbitals filling up => more e^-s => more repulsion => gets larger!

Ionization E (IE) → E change associated w/ removing an e^-.

ex. Na + E → Na^+ + e^-

↳ deals w/ cation formation.

496 kJ / 1 mol → 6.022×10^{23}

differs for elements.

- Across the period (L → R) → IE ↑ b/c more protons [nuclear charge ↑] → more E to remove e^-s. higher hold on e^- from nucleus.

11-29-05

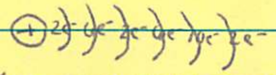
Ionization of an Atom → E required to remove an e- from an atom ; units → KJ/mol.

1st IE : $A + E \longrightarrow A^+ + e^-$

2nd IE : $A^+ + E \rightarrow A^{2+} + e^-$, etc.

Trends of IE
- across the period (L → R) → IE generally increases → b/c nuclear charge increases in localized area, e-s pulled closer & therefore it takes more E to remove an e-.

- Down a group → IE ↓ b/c
  1) each period = an E level
     ⇒ e-s farther away from nucleus
     - nucleus doesn't have a very strong hold on those e-s
     ⇒ easier to remove an e-.



  - b/c outer shell e- are farther away from nucleus as new E levels are added, so nuclear charge has less of a hold on the e-

  [ex. of 20 kids in a room vs 60 kids in a room]

  2) "inner shell e- shielding"
     → shielding of nuclear charge by inner shell e-s creates less a hold on the outershell e-.

Exceptions in IE → b/c of inner shell e- shielding [like w/ Gr. 11, 12 & 13]
- b/c of full d-orbital.

- 2nd IE → more difficult to remove ⇒ higher IE level. [always]
  - b/c atom is (+) → more E to remove an e-.

[ex. of parent's attention on 2 kids vs 1 kid ⇒ harder to get away]

12-01-05

Electron affinity (e-A) → E change associated w/ the taking on of e-. [one likes it]
⇒ anion formation [like Cl-]

- occurs readily.
- [like a Gr. 17 elem.] $A + e^- \longrightarrow A^- + E$ [exothermic Process : E is released] → value will be released in (-) $\frac{KJ}{mol}$ ☆
- [ex. → Noble Gases] $A + e^- + E \longrightarrow A^-$ [endothermic Process : E is absorbed] → value will be (+) $\frac{KJ}{mol}$ ☆

[Mr. Guerin + turkey + E ⟶ thanksgiving]

Trends (have to look group by group)

- Gr 17 → high (-) e-A [readily takes on e-s ⇒ giving off E)
  - b/c 7 val. e-s, needs 1 more e- ⇒ stable e- configuration.
  ⇒ full outer shell [octet]

- Gr 1 → low (-) e-A
  - would much rather lose an e- (than gain an e-) to get an octet.
  - but attract w/ addition of e- → s-orbital's filled
  ⇒ little more stable.

- Gr 18 → low (+) e-A (requires E to take on e-s) b/c
  → new e- being added to next highest E level - farther from other e-s
  ⇒ less repulsion forces.
  so less E is required

- Gr 2 → high (+) e-A → b/c new e- is at the same E level ⇒ close to preexisting e-s
  ⇒ lots of repulsion
  ⇒ higher E required.

12-05-05

- e⁻ affinity (wrap up) → making anions
  - Gr 2 → has more repulsion.

<u>Ionic Radii</u> : 1/2 the distance between nuclei of adjacent ions.

- <u>cations</u> → atom is larger than ion → b/c when an e⁻ is lost, there is a larger charge balance in favor of protons so the e⁻'s are pulled in closer to the nucleus.
- <u>anions</u> → ion is larger → b/c extra e⁻ induces e⁻ repulsion in atom so ion gets larger.
- metals → typically make cations

<u>Trends</u>

- across the period (L→R) → IR decreases b/c more (+)'s, pulling e⁻'s in [see atomic radius (AR)]
  [jumps up to anions → but still, it cont.'s to go down]
- down the group → IR increases b/c more E-levels ⇒ farther from nucleus [see AR]

(e-neg) → <u>Electronegativity</u> ; the attraction of an atom for an e⁻ w/in a <u>chemical bond</u>. ⇒ unequally sharing e⁻'s

- scale → 0 to 4 (F being the highest (4))
- invented by Linus Pauling — units → usually not given → but sometimes called "Paulings"

- H – Cl
  2.1   3.0
  unequal sharing of e⁻'s

12-06-05

cont. for e-neg → scale : 0.0 – 4.0
↑ highest e-neg (F) readily attracts e⁻ in a chemical bond

- e⁻ density of H–Cl - - → (H – Cl)
  ↑ e⁻ density around Cl higher b/c Cl is more e-neg
  - therefore Cl is partially (−) & H is partially (+)

so... $^{+}\delta$ H – Cl $^{-}\delta$ — "delta" - partial charge.
→ same thing = H ⟶ Cl ← dipole

- e-neg is the basis for a <u>polar molecule</u> (separation of charge)

<u>Trends (e-neg)</u>

- <u>Across the period (L→R)</u> : goes ↑ b/c # of protons increases across the period ⇒ nuclear charge ↑ ⇒ causing a stronger attraction for e⁻
- <u>Down a group</u> : e-neg ↓ b/c 1) outer shell far away from nucleus ⇒ less e⁻ attraction
  2) e⁻ shielding
  3) more repulsion. b/c of more E-levels.

<u>Game Time</u> what's bigger

- H or (Rb) → AR
- (B) or O → AR
- S or (I) → IE
- F or (Cl) → IE
- Ag or (Cd) → IE [end of d block] → an exception!
- (Na⁺) or Mg^{2+} → AR ↳ more (+)'s so smaller
- (O^{2-}) or F^{-} → AR → more repulsion